Single Dopants in Fermi-Hubbard Systems - Probing Spin-Charge (de-)coupling

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The Hubbard model, a simple yet in general not solvable model for high-Tc superconductors, offers an intriguing playground to explore strongly correlated many-body systems. Quantum simulators based on ultracold fermions in optical lattices allow for the experimental study of the Hubbard model in pristine form. They provide experimental probing and control possibilities down to the level of single "electrons" and their spins. Much of the complexity of the Hubbard model arises from the interplay of spin and charge degrees of freedom. Here we report on the experimental study of one- and two-dimensional synthetic Hubbard systems implemented on the optical lattice platform. We discuss our recent observations of spin-charge separation in one dimension and the imaging of magnetic polarons in two dimensions. Future extensions of these experiments may allow one to study the interaction of polarons as a precursor to collective many-body physics in the Hubbard model.